

6. A method as set forth in claim 1, in which said surface treatment is coating of the surface and said substrate has an interlayer insulative film layer as a top

forming a diffusion barrier layer in contact with the interlayer insulative film layer by depositing predetermined component elements of the gas onto the surface of the interlayer insulative film layer; and

7. A method as set forth in claim 6, in which the interlayer insulative film layer is formed from a material consisting essentially of an organic material of low dielectric constant and the diffusion barrier layer is formed from a metal or a compound.

10. A method as set forth in claim 1, in which said surface of the substrate is provided with a recess and said surface treatment is coating of the surface, said method further comprising the steps of:

11. A method as set forth in claim 10, in which said fast particle beam is a collimated beam.

13. A method as set forth in claim 1, in which the surface treatment is an anisotropic dry etching, said method comprising the steps of:

irradiating the surface of the substrate with a fast particle collimated beam to enhance an activity of the surface and/or the gas thereby increasing a rate of the removal of the material of the substrate in a direction along which the collimated beam is directed towards the surface of the substrate.

15. A method of etching a surface of a substrate, comprising the steps of:

irradiating the surface of the substrate with an ultraviolet light beam or a laser beam to enhance an activity of the surface and/or the gas thereby increasing a rate of the removal of the material of the substrate in a direction along which the collimated beam is directed

towards the surface of the substrate.

16. An apparatus for applying a surface treatment to a surface of a substrate, the surface treatment being selected from a group consisting of the following surface treatments: coating, denaturation, modification and etching, said apparatus comprising:

a reactor housing in which the surface treatment is conducted;

a source for supplying a gas into said reactor housing; and

a fast particle beam device for generating a fast particle beam and irradiating the surface of the substrate with the beam so as to enhance an activity of the surface and/or the gas thereby facilitating reaction between the surface and the gas.

17. An apparatus as set forth in claim 16, in which said fast particle beam device supplies a beam selected from a group consisting of an electron beam, a charged particle beam, an atomic beam and a molecular beam.

18. An apparatus as set forth in claim 17, in which said apparatus further comprises a reactor housing, and a turntable provided in the reactor housing and having an axis about which the turntable is rotated and a surface normal to the axis for receiving a flat substrate thereon, and said fast particle beam device directs the beam towards the surface of the substrate at an angle relative to the surface.

19. An apparatus for generating a fast particle beam comprising:

a housing for receiving a predetermined gas,

anode and cathode plates provided in said housing with a predetermined spacing being interposed therebetween and arranged in parallel with each other, anode and cathode plates each being provided with a plurality of through holes, said spacing being set to be in the range of $D/14 - D$, in which D is a diameter of the anode and cathode plates,

the anode and cathode plates being adapted to be applied with a high voltage to cause a plasma discharge

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20. An apparatus as set forth in claim 19, in which said range is 1 mm - 14 mm.